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The new system, for the first time, uses powerful Microsoft Windows Software for various options of DLTS measurements and data analyses. However, Phys Tech, which is a contractor of Accent and responsible for writing the software, did not provide us with a detailed manual of the DLTS Software until July of this year (we only received a draft of the Software manual in July). Therefore, we still have to learn how to operate the system in detail.

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Final DURIP Report

to

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Report on a new DLTS system (DL8030)

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A new DLTS system (DL8030), which was ordered from Accent Optical Technologies (UK) Ltd., arrived at Wright State University in early October, 2002, and was installed in the second week of December, 2002. The system has two cryostats, i.e., a LN_2 cryostat with four micromanipulators and a closed cycle He cryostat. The DL8030 system is a PC driven, software based, digital Deep Level Transient Spectrometer, which uses the method of Fourier transformation for the investigation of deep level characteristics. We will use the system to study deep levels in wide bandgap semiconductors, i.e., GaN, SiC and ZnO. During the installation and brief training, an engineer from Phys Tech GmbH in Germany showed us many options, which include Capacitance-DLTS, Conductance-DLTS, Isothermal DLTS, and Constant-Capacitance DLTS. The new system, for the first time, uses powerful Microsoft Windows Software for various options of DLTS measurements and data analyses. However, Phys Tech, which is a contractor of Accent and responsible for writing the software, did not provide us with a detailed manual of the DLTS Software until July of this year (we only received a draft of the Software manual in July). Therefore, we still have to learn how to operate the system in detail.

The two examples presented below demonstrate the capability of measuring deep levels below 80 K, by using the He cryostat. We have known that a DLTS center (trap E) at E_C-0.18 eV can be induced in MOCVD-GaN by 1-MeV electron-irradiation (EI) and the trap actually consists of at least two components, each of which has a thermal energy near 60 meV, but with different capture cross-sections [APL 76, 2086 (2000)]. To fully understand the characteristics of trap E, we have performed 1-MeV EI on an HVPE-GaN sample and measured DLTS spectra (from 300 K to 40 K) using different filling pulse lengths, as shown in Fig. 1. From the figure, we see that the peak of trap E shifts to lower temperatures as the pulse length increases. As compared to traps B and D, which do not shift, trap E has a smaller apparent capture cross-section.

Porous SiC (PSC) has been an object of interest for reducing defects in epitaxial SiC layers grown on PSC substrates. We had earlier performed DLTS measurements on a SiC-on-PSC

sample using our old Bio-Rad DL4600 system; however, many shallow centers below 80 K could not be revealed (Abstracts, 2003 EMC). By using the DL8030 system, Ti and N-related shallow centers (traps E, F, and G) can be clearly observed, as shown in Fig. 2.

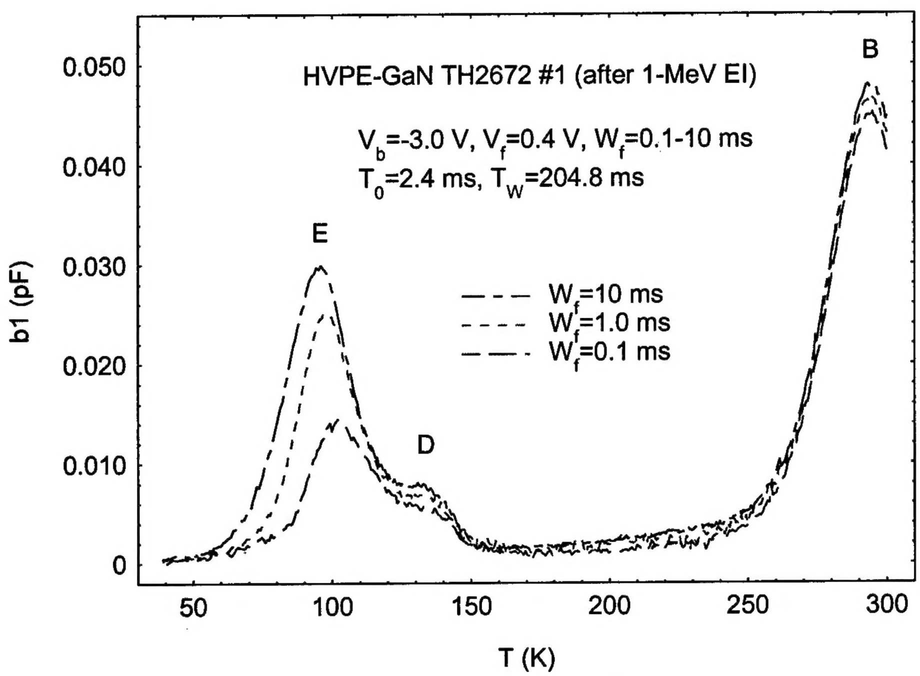

Fig. 1 DLTS spectra with different W_f for HVPE-GaN, irradiated by 1-MeV electrons

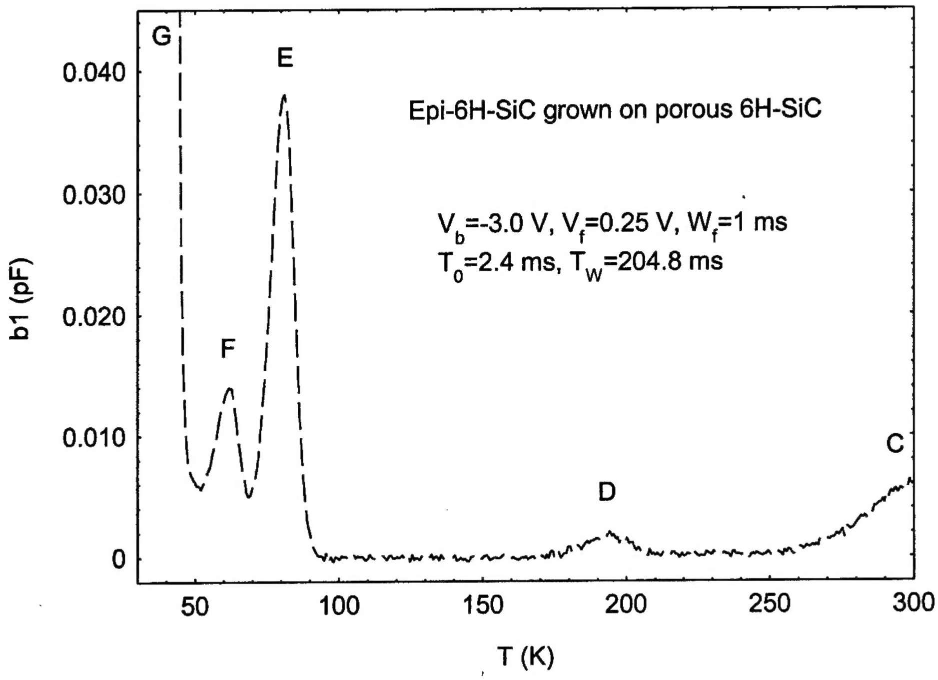

Fig. 2 DLTS spectrum for epitaxial 6H-SiC grown on porous 6H-SiC substrate